

INCH-POUND

MIL-PRF-1/1589D(NAVY)  
 12 July 1999  
 SUPERSEDING  
 MIL-E-1/1589C(NAVY)  
 26 August 1975

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, KLYSTRON  
 TYPE 8237 \*

This specification is approved for use by the Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein shall consist of this document and the latest issue of MIL-PRF-1.

**DESCRIPTION:** Amplifier, pulsed, 2,900 to 3,100 MHz.

**ABSOLUTE RATINGS:**

| Parameter:<br>Unit: | Ef<br>V ac | if (surge)<br>a | tk<br>minutes | I(focus)<br>A  | epy<br>kv | epx<br>kv | ik<br>a | lk<br>mA | Pi<br>kW | Du<br>--- |
|---------------------|------------|-----------------|---------------|----------------|-----------|-----------|---------|----------|----------|-----------|
| Maximum:            | 7.88       | 54              | ---           | 6.0            | 105       | 30        | 68      | 285      | 24       | 0.0042    |
| Minimum:            | 7.12       | ---             | 12            | 3.8 <u>23/</u> | ---       | ---       | ---     | ---      | ---      | ---       |

| Parameter:<br>Unit: | Po<br>kW | tp<br>μs | prp<br>pps | VSWR<br>--- | T(outlet<br>coolant)<br>°C | Coolant flow<br>(distilled water)<br>GPM |       | Coolant flow<br>(60/40 ethylene glycol)<br>GPM |      |
|---------------------|----------|----------|------------|-------------|----------------------------|--|-------|--|------|
|                     |          |          |            |             |                            | Collector                                | Body  | Collector                                      | Body |
| Maximum:            | 6.72     | 11       | 2,000      | 2.5:1       | 85                         | ---                                      | ---   | ---  | ---  |
| Minimum:            | ---      | ---      | ---        | ---         | ---                        | 4  | 0.625 | 8  | 2    |

| Parameter:<br>Unit: | Waveguide<br>pressurization (dry air)<br>psia | Hydrostatic pressure<br>psig | TA<br>°C  | TA<br>°C      |
|---------------------|---|------------------------------|-----------|---------------|
|                     |   |                              | Operating | Nonoperating  |
| Maximum:            | 55  | 200                          | +85       | +85           |
| Minimum:            | 24  | ---                          | -20       | -62 <u>7/</u> |

**PHYSICAL CHARACTERISTICS:**

|           |                         |             |                             |
|-----------|-------------------------|-------------|-----------------------------|
| Base:     | Special (See figure 1). | Input:      | Coaxial connector UG-972/U. |
| Mounting: | 5/                      | Output:     | "S" band waveguide.         |
| Weight:   | 130 pounds (max).       | Dimensions: | See figure 1.               |

**TEST CONDITONS:**

| Parameter:<br>Unit: | Ef<br>Vac | tk<br>minutes | I(focus)<br>A | epy<br>kv    | pd<br>---  | tp<br>μs     | Du(rf)<br>---    | VSWR<br>--- | Coolant flow<br>(distilled water)<br>GPM |                    |
|---------------------|-----------|---------------|---------------|--------------|------------|--------------|------------------|-------------|--|--------------------|
| Tolerance:          | ---       | minimum       | ---           | ±5           | ---        | ±1           | ---              | ---         | ---                                      |                    |
| Test 1:             | 7.5       | 12            | <u>23/</u>    | 90           | <u>15/</u> | 10           | 0.0042           | 1.2:1       | <u>Collector</u><br>6.0                  | <u>Body</u><br>1.5 |
| Test 2:             | 7.8       | 12            | <u>23/</u>    | 96 <u>2/</u> | <u>15/</u> | 10 <u>3/</u> | 0.0039 <u>4/</u> | 1.5:1       | 6.0                                      | 1.5                |

See footnotes at end of table I.

**GENERAL:**

Qualification - Not required.

\* Replaces types: VA811C, L-3742.

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TABLE I. Testing and inspection.

| Inspection                            | Method | Notes              | Test | Conditions  | Symbol                   | Limits |          | Unit         |
|---------------------------------------|--------|--------------------|------|---|--------------------------|--------|----------|--------------|
|                                       |        |                    |      |   |                          | Min    | Max      |              |
| <u>Conformance inspection, part 1</u> |        | <u>1/</u>          |      |   |                          |        |          |              |
| Pressurizing (waveguide)              | 4003   | <u>8/</u>          | ---  | Method A; 55 psia;<br>t = 900   | ---                      | ---    | ---      | ---          |
| Hydrostatic pressure                  | ---    | <u>8/</u>          | ---  | 140 psig; collector and body inlet closed                                   | ---                      | ---    | ---      | ---          |
| Forced cooling (pressure drop)        | 1143   | ---                | ---  | 4 GPM to collector<br>1 GPM to body (distilled water)                       | $\Delta P$<br>$\Delta P$ | 6<br>4 | 20<br>20 | psia<br>psia |
| Heater current, nonoperating          | 4289   | ---                | ---  | Ef = 7.5 V;<br>tk = 720 (minimum)   | If                       | 27     | 38       | A            |
| Electrode current (cathode)           | 1256   | ---                | 1    | pd = 0  | ik                       | 49.6   | 58.4     | a            |
| Power output                          | 4250   | <u>6/ 14/</u>      | 1    | F = 2,910 to 3,100 MHz  | po                       | ---    | ---      | kw           |
| Output power variation (1)            | 4251   | <u>21/</u>         | 1    | pd = $\pm 1$ dB from the identification plate value; F = 2,980 to 3,100 MHz | $\Delta po(1)$           | ---    | ---      | kw           |
| Output power variation (2)            | 4251   | <u>9/ 21/</u>      | 1    | l(focus) = $\pm 2$ percent from identification plate value                  | $\Delta po(2)$           | ---    | ---      | kw           |
| Cathode emission                      | 4214   | <u>17/</u>         | 1    | pd = 0  | $\Delta ik/ik$           | ---    | 10       | %            |
| Stability                             | 4261   | ---                | 1    | pd = 0  | po                       | ---    | 2        | w            |
| X-radiation                           | 4006   | <u>14/ 16/</u>     | 1    |   | ---                      | ---    | 3        | mr/hr        |
| <u>Conformance inspection, part 2</u> |        |                    |      |   |                          |        |          |              |
| Permanence of marking                 | 1105   | ---                | ---  |   | ---                      | ---    | ---      | ---          |
| Output power variation (3)            | 4251   | <u>22/</u>         | 1    | epy = 90 kv +3 to -7 percent  | $\Delta po(3)$           | ---    | ---      | kw           |
| Direct-interelectrode capacitance     | 4266   | <u>13/</u>         | ---  |   | Cak                      | ---    | 30       | pF           |
| Internal arc                          | ---    | <u>19/</u>         | 2    | F = 2,980 to 3,100 MHz  | ---                      | ---    | ---      | ---          |
| <u>Conformance inspection, part 3</u> |        |                    |      |   |                          |        |          |              |
| Life test                             | ---    | <u>6/</u>          | 1    | Group D   | t                        | 1,000  | ---      | hrs          |
| Life test end-point:                  | ---    |                    |      |   |                          |        |          |              |
| Power output                          | 4250   | ---                | 1    | 2,980 to 3,100 MHz  | po                       | 800    | ---      | kw           |
| Low-frequency vibration               | 1031   | <u>10/ 18/ 24/</u> | ---  | No voltages applied   | ---                      | ---    | ---      | ---          |

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

| Inspection  | Method | Notes              | Test | Conditions                           | Symbol | Limits |       | Unit |
|---|--------|--------------------|------|--------------------------------------|--------|--------|-------|------|
|   |        |                    |      |                                      |        | Min    | Max   |      |
| <u>Conformance inspection, part 3</u> - Continued |        |                    |      |                                      |        |        |       |      |
| Variable-frequency vibration                      | 1031   | <u>10/ 18/ 24/</u> | ---  | No voltages applied                  | ---    | ---    | ---   | ---  |
| Vibration fatigue                                 | 1031   | <u>18/ 24/</u>     | ---  | Ef = 7.5 V                           | ---    | ---    | ---   | ---  |
| Shock, specified pulse                            | 1042   | <u>12/ 18/ 24/</u> | ---  | 10 G; t = 11 ms; no voltages applied | ---    | ---    | ---   | ---  |
| Humidity  | 1011   | <u>18/ 24/</u>     | ---  | t = 96 hours                         | ---    | ---    | ---   | ---  |
| Ion pumps   | 4268   | <u>11/ 18/</u>     | ---  |                                      | ---    | ---    | ---   | ---  |
| Heater resistance, cold                           | ---    | <u>18/</u>         | ---  |                                      | ---    | 0.023  | 0.030 | Ohms |
| Waveguide arc                                     | ---    | <u>18/ 20/</u>     | 1    | VSWR = 1.5:1                         | ---    | ---    | ---   | ---  |

- 1/ Inspection shall be 100 percent.
- 2/ Any short transient spike on the voltage pulse shall not exceed 115 kv in magnitude.
- 3/ The pulse duration (tp) is defined as the time interval between the first and last instances at which the instantaneous amplitude attains 90 percent of the peak amplitude excluding spikes.
- 4/ One scan cycle shall consist of rf pulses of 10, 4.6, or 2.5 μs programmed within the following limits:
  - a. The maximum instantaneous duty cycle (defined as d/D, where d = pulse width in seconds and D = time separation in seconds between the leading edges of two successive pulses) shall be 0.011.
  - b. The scan cycle program shall be such that the average duty cycle shall not exceed 0.0042 over the scan cycle which shall have a maximum duration of 30,000 μs.
- 5/ The tube under test (TUT) shall be mounted with its beam axis within 30 degrees of the vertical. A flexible length of waveguide or other equivalent connection shall be provided between the TUT output flange and load or output waveguide system to prevent excessive forces from being applied to the output flange. The cathode stem shall be immersed in oil as shown on figure 1.
- 6/ The TUT shall amplify frequencies over the band from 2,910 to 3,100 MHz without any change of the electrical or mechanical parameters. Further, in setting up for the conformance inspection, part 1 tests, the focus coil currents, the drive power, and other parameters (within their specific ranges), shall be adjusted to the values specified herein. Once adjustment values are set, no further change in values shall be allowed.
- 7/ During storage and extended nonoperating periods, the coolant shall be removed to avoid damage to the tube and cooling paths shall be dried and sealed.
- 8/ There shall be no leakage at maximum limit specified herein.
- 9/ The TUT shall provide the power output specified herein when each coil current is varied ± 2 percent of the value specified on the identification plate. All coil current shall be varied simultaneously in the same polarity.
- 10/ The TUT shall be vibrated in each of two planes specified below:
  - a. Where the orientation of the TUT has the main axis and major cross section of the TUT elements normal to the direction of the accelerating force.
  - b. Where the orientation of the TUT has the main axis of the TUT normal and the major cross section parallel to the accelerating force.

TABLE I. Testing and inspection - Continued.

11/ The Vacion pump, or equivalent, shall have the following ratings:

ABSOLUTE RATINGS:

| Unit:    | <u>kV</u> | <u>mA</u> | <u>V(pk ripple)</u> |
|----------|-----------|-----------|---------------------|
| Maximum: | 3.2       | 10        | 108                 |
| Minimum: | ---       | ---       | ---                 |

Absolute ratings for the pump apply during all conditions. The pump current is proportional to the voltage applied and the pressure in the pump. The pump is operative when the applied voltage is between 2.0 and 3.2 kV.

12/ This test shall be conducted prior to all electrical tests. The TUT shall be subjected to a total of 20 shocks; five shocks in each of the planes specified below:

- a. Where the orientation of the TUT has the main axis and major cross section of the TUT elements normal to the direction of the accelerating force.
- b. Where the orientation of the TUT has the main axis of the TUT normal and major cross section parallel to the accelerating force.
- c. Where the orientation of the TUT has the main axis parallel to the accelerating force and the base down or toward the hammer.
- d. Where the orientation of the TUT has the main axis parallel to the accelerating force and the base up and away from the hammer.

13/ The anode to cathode capacitance shall be measured with the TUT in the air, without filaments and beam voltage leads connected.

14/ RF power output versus frequency:

| <u>Frequency (MHz)</u> | <u>Minimum output power (kw)</u> | <u>Maximum output power (kw)</u> |
|------------------------|----------------------------------|----------------------------------|
| 3,100 to 2,980         | 1,000                            | 1,600                            |
| 2,970                  | 446                              | 1,600                            |
| 2,960                  | 178                              | 1,600                            |
| 2,950                  | 71                               | 1,600                            |
| 2,940                  | 35.5                             | 1,600                            |
| 2,930                  | 25                               | 1,600                            |
| 2,920                  | 20                               | 1,600                            |
| 2,910                  | 16                               | 1,600                            |

15/ A 316 watt pulse (max) shall be permissible over passband of 2,910 to 3,100 MHz. Once chosen, the drive power over the passband shall be constant and shall be recorded on the identification plate. A specified tolerance of ± 0.35 dB will be allowed for instrumentation errors.

16/ X-ray shielding shall be sufficient to reduce X-radiation to 3 mr/hr at a distance of 3 feet from any integral part of the tube above the bottom pole piece, except for conical regions whose axes are colinear with the axis of each coolant fitting.

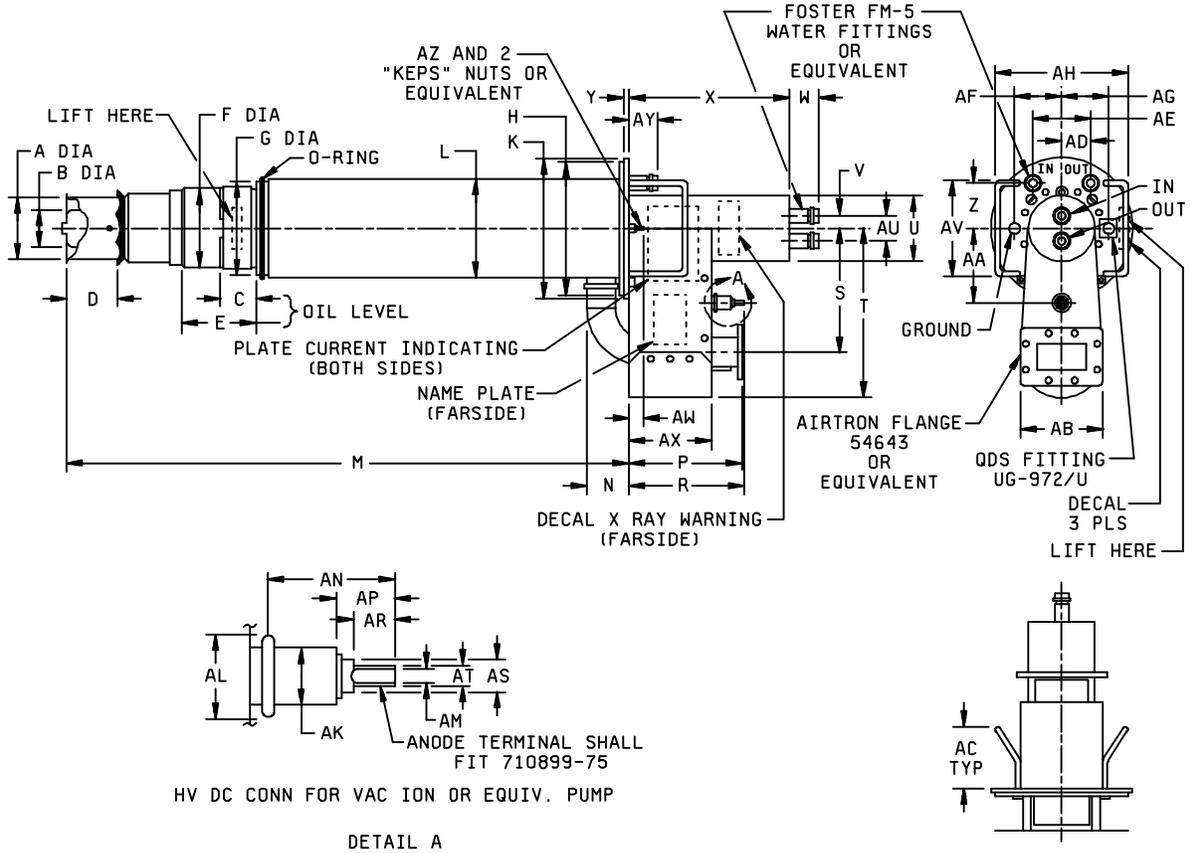
17/ When operating under cathode current test conditions, Ef shall be decreased from 7.5 to 6.75 V and the cathode emission allowed to stabilize. The percent change in ik shall not exceed the value specified herein.

$$\frac{ik(Ef = 7.5 V) - ik(Ef = 6.75 V)}{ik(Ef = 7.5 V)} \times 100$$

18/ This test shall be performed during the initial production and once each succeeding 12-calendar months in which there is production. A regular double sampling plan shall be used, with the first sample of three tubes with an acceptance number of zero, and a second sample of three tubes with a combined acceptance number of one. In the event of failure, the test will be made as a part of conformance inspection, part 2, code level D, with an acceptance level of 6.5. The regular "12-calendar month" double sampling plan shall be reinstated after three consecutive samples have been accepted.

TABLE I. Testing and inspection - Continued.

- 19/ Internal arc shall be the first test following the holding period. The TUT shall be operated continuously for 6 hours. The epy shall be applied at 65 kv (min). The time allowed for the voltage to reach 96 kv (min) shall be 10 seconds (max). Immediately following application of epy for the duration of the 6-hour operational tests, the peak cathode current shall be monitored at the cathode terminal for peak pulse amplitude variation. During the first 15 minutes of the test, the peak cathode current shall not exceed the normal cathode current by 20 percent more than twice. During the remaining 5 hours and 45 minutes, the peak cathode current shall not exceed the normal cathode current by 20 percent more than once.
- 20/ Each TUT shall be operated continuously for 1-hour minimum. The frequency for this test shall be at the maximum power point as determined in power output. The phase of the VSWR shall be uniformly varied over a 360 degree range at a maximum rate of 6-cycles per hour. Under this condition, the pressure in the output waveguide of the tube shall be reduced to 24 psia (max). The tube shall operate for one-half hour with no evidence of waveguide arcing.
- 21/ Same as 14/ except po = 900 kw minimum for range of 2,980 through 3,100 MHz.
- 22/ Same as 14/ except po = 700 kw minimum for range of 2,980 through 3,100 MHz.
- 23/ The tube focus coil to be used with the TUT shall be as shown on figure 2. The focus coil operating current for each of the six coils shall be between 4.0 and 5.5 A, and shall be recorded on the TUT identification plate.
- 24/ After the completion of these tests, the TUT shall meet the requirements of method 4250 (power output).
- 25/ Marginal notations letters are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.



NOTES:

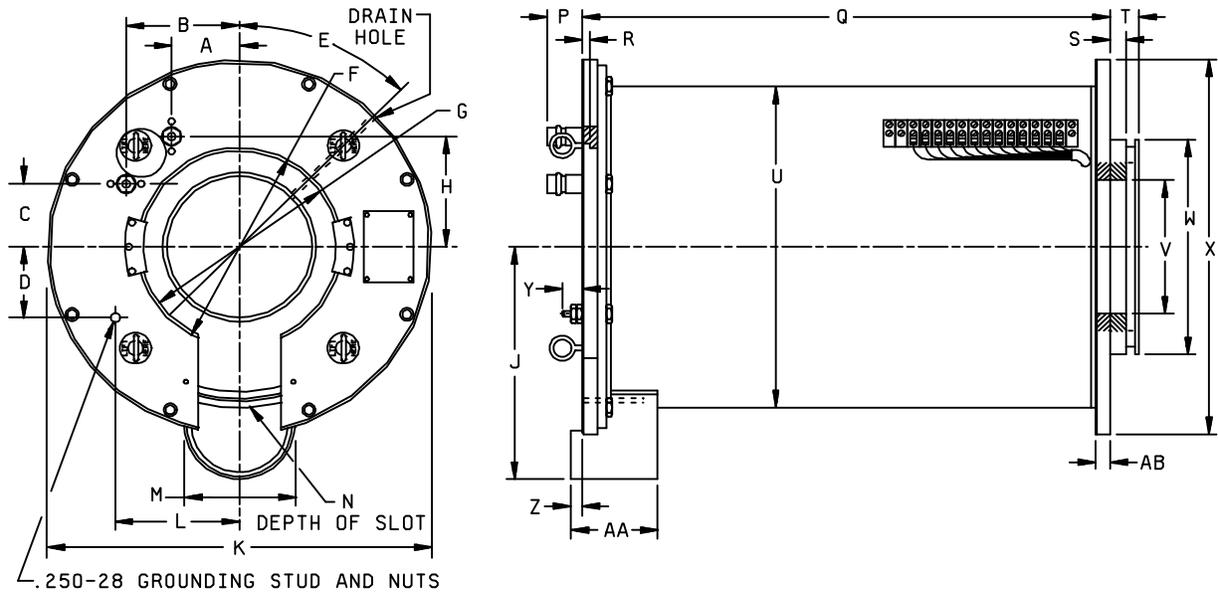
1. Identification of dimension "P". Top of mounting base to top of waveguide flange.
2. Identification of dimension "R". Top of mounting base to top of vac-ion pump terminal.

FIGURE 1. Outline drawing of electron tube type 8237.

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| Ltr                            | Dimensions       |        |                  |        |
|--------------------------------|------------------|--------|------------------|--------|
|                                | Inches           |        | Millimeters      |        |
|                                | Min              | Max    | Min              | Max    |
| Conformance inspection, part 1 |                  |        |                  |        |
| A                              | 3.285            | 3.295  | 83.44            | 83.69  |
| B                              | 2.012            | 2.022  | 51.10            | 51.36  |
| C                              | ---              | 2.00   | ---              | 50.8   |
| D                              | 1.763            | 2.900  | 44.78            | 73.66  |
| E                              | 4.00             | ---    | 101.6            | ---    |
| F                              | 4.595            | 4.655  | 116.71           | 118.24 |
| G                              | 5.347            | 5.357  | 135.81           | 136.07 |
| M                              | 30.567           | 30.941 | 776.40           | 785.90 |
| N                              | ---              | 2.375  | ---              | 60.32  |
| P                              | 6.307            | 6.507  | 160.20           | 165.28 |
| R                              | 6.313            | 6.563  | 160.35           | 166.70 |
| S                              | 6.922            | 7.172  | 175.82           | 182.17 |
| T                              | 9.296            | 9.546  | 236.12           | 242.47 |
| U                              | 3.662            | 3.712  | 93.01            | 94.28  |
| V                              | .943             | .993   | 23.95            | 25.22  |
| W                              | 1.50             | 1.73   | 38.1             | 43.9   |
| X                              | 8.925            | 9.175  | 226.70           | 233.04 |
| Y                              | .235             | .265   | 5.97             | 6.73   |
| Z                              | 2.531            | 2.655  | 64.29            | 67.44  |
| AA                             | 4.115            | 4.365  | 104.52           | 110.87 |
| AB                             | 4.735            | 4.765  | 120.27           | 121.03 |
| AC                             | 3.125            | 3.625  | 79.38            | 92.08  |
| AD                             | 1.438            | 1.562  | 36.52            | 39.67  |
| AE                             | 2.938            | 3.062  | 74.62            | 77.77  |
| AF                             | 2.688            | 2.812  | 68.27            | 71.42  |
| AG                             | 2.438            | 2.562  | 61.92            | 65.07  |
| AH                             | 6.687            | 6.937  | 169.85           | 176.20 |
| AM                             | .142             | .172   | 3.61             | 4.37   |
| AT                             | .235             | .265   | 5.97             | 6.73   |
| AU                             | 1.876            | 1.996  | 47.65            | 50.70  |
| AV                             | 5.375            | 5.625  | 136.52           | 142.87 |
| AW                             | .565             | .685   | 14.35            | 17.40  |
| AX                             | 4.469            | 4.672  | 113.51           | 118.67 |
| AY                             | 1.600            | 1.680  | 40.64            | 42.67  |
| AZ                             | .250-28 SST STUD |        | 6.35-28 SST STUD |        |
| Reference dimensions           |                  |        |                  |        |
| H                              | 7.750 DIA        |        | 196.85 DIA       |        |
| K                              | 8.000 DIA        |        | 203.20 DIA       |        |
| L                              | 5.450            |        | 138.43           |        |
| AK                             | .75 DIA          |        | 19.0 DIA         |        |
| AL                             | 1.03 DIA         |        | 26.2 DIA         |        |
| AN                             | 1.67             |        | 42.4             |        |
| AP                             | .78              |        | 19.8             |        |
| AR                             | .53              |        | 13.5             |        |
| AS                             | .42              |        | 10.7             |        |

FIGURE 1. Outline drawing of electron tube type 8237 - Continued.



| Dimensions |        |        |             |        |     |        |        |             |        |
|------------|--------|--------|-------------|--------|-----|--------|--------|-------------|--------|
| Ltr        | Inches |        | Millimeters |        | Ltr | Inches |        | Millimeters |        |
|            | Min    | Max    | Min         | Max    |     | Min    | Max    | Min         | Max    |
| A          | 2.438  | 2.562  | 61.93       | 65.07  | P   | 1.125  | 1.625  | 28.57       | 41.27  |
| B          | 4.250  | 4.374  | 107.95      | 111.10 | Q   | 20.250 | 20.374 | 514.35      | 517.50 |
| C          | 2.438  | 2.562  | 61.93       | 65.07  | R   | .219   | .281   | 5.56        | 7.14   |
| D          | 2.657  | 2.843  | 67.49       | 72.21  | S   | .531   | .655   | 13.49       | 16.64  |
| E          | 45°    |        | 45°         |        | T   | 1.063  | 1.187  | 27.00       | 30.15  |
| F          | 8.015  | 8.045  | 203.58      | 204.34 | U   | 12.625 | 12.875 | 320.67      | 327.02 |
| G          | 7.775  | 7.805  | 197.48      | 198.25 | V   | 5.358  | 5.364  | 136.09      | 136.24 |
| H          | 4.250  | 4.374  | 107.95      | 111.10 | W   | 8.487  | 8.497  | 215.57      | 215.82 |
| J          | 9.047  | 9.171  | 229.79      | 232.94 | X   | 14.688 | 14.812 | 373.07      | 376.22 |
| K          | 14.688 | 14.812 | 373.07      | 376.22 | Y   | .688   | .812   | 17.47       | 20.62  |
| L          | 4.594  | 4.780  | 116.69      | 121.41 | Z   | .375   | .385   | 9.52        | 9.78   |
| M          | 4.063  | 4.125  | 103.20      | 104.78 | AA  | 3.313  | 3.437  | 84.15       | 87.30  |
| N          | 2.185  | 2.205  | 55.50       | 56.01  | AB  | .438   | .562   | 11.12       | 14.27  |

FIGURE 2. Focusing electromagnet.

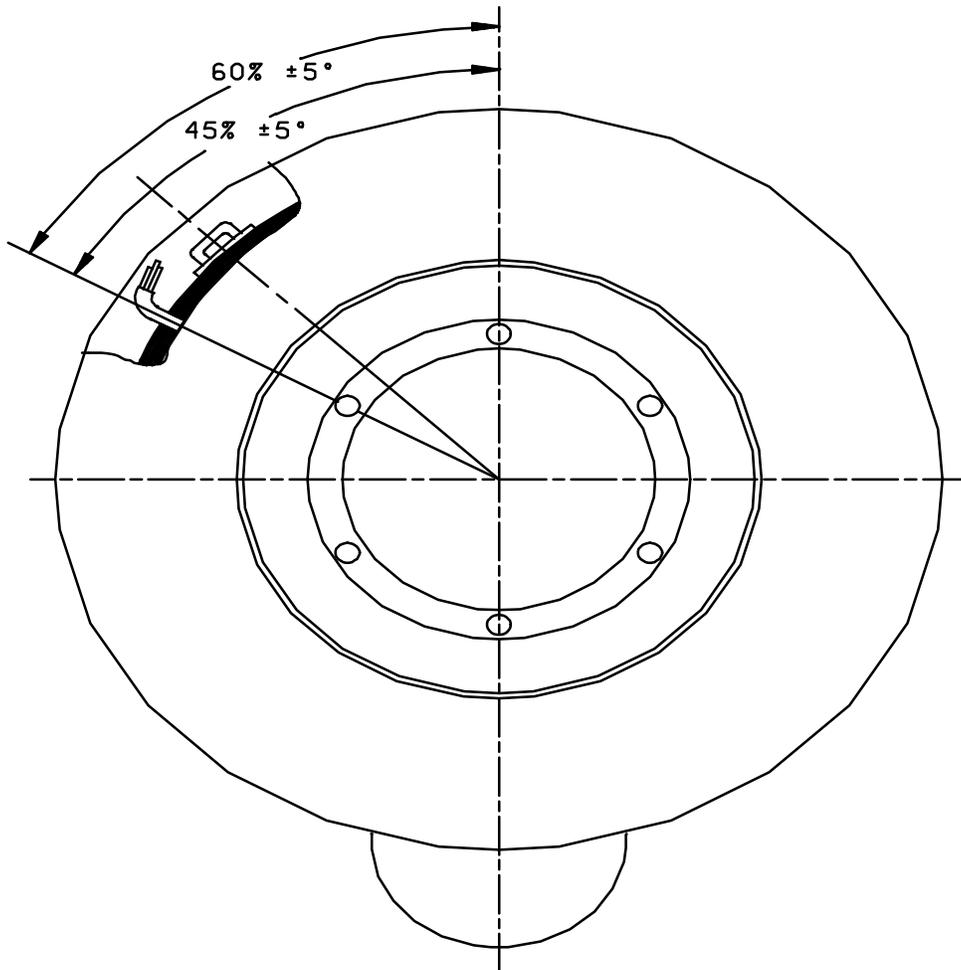


FIGURE 3. Focusing electromagnet - Continued.

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Custodians:

Navy - EC  
DLA - CC

Review activities:

Navy - AS, CG, MC, OS

Preparing activity:

DLA - CC

(Project 5960-3547-06)